

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 70.

Abnormal Deposits on Vine Leaves.

On May 14th a few leaves from a Muscat vine were received from E. H. Loveland, foreman of the Butler vineyard at Fresno. Mr. Loveland's attention had been attracted by what seemed to be a growth of fungus on the leaves and on one side of the trunk of the vine. He wrote that he had noticed the same thing before, but never in such amount as this season.

A preliminary examination of the specimens showed that the leaves, though appearing quite healthy in color, were thickly covered on both sides with a whitish substance occurring in irregular masses, and which at first glance might give some suspicion of a fungoid growth. Examined with a hand-magnifier, however, the material was seen to be of dense character and prone to lift from the surface of the leaf in scale-like particles—in fact, in some places, especially where it had extended over the ribs of the leaf, it had divided and partly lifted itself from the surface as though it had become shrunken and distorted by drying. No features of fungoid growth were discernible. Upon careful exploration with a three-fourth inch objective the marks shown by the hand-magnifier were made more plain, and the whitish masses gave indications of a crystalline structure, manifesting itself in two main forms. The thinner portions were chiefly made up of flattish crystallizations of arborescent form, spreading out upon the surface of the leaf, and the thicker parts were dense white masses covered thickly with acicular crystals. The whole appearance of the material was that of an incrustation held in place by adhesion and by interweaving of the leaf hairs through it, the latter fact indicating that it had come upon the leaf in a fluid state and had thus taken close hold upon the inequalities of the leaf surface. This being the character of the deposit as determined by the microscope, and as no traces of fungoid origin could be discerned, it was evident that the composition of the material, as determined by chemical examination, would be most apt to disclose its source.

The small amount of material which could be scraped from the leaves, somewhat less than one grain, rendered it impossible to come to perfectly definite conclusions regarding its exact nature.

The original material contained:

44.3 per cent insoluble in water.

55.7 " " soluble " "

Of the soluble part:

69.8 per cent was organic matter and water.

7.2 " " " soluble ash.

23.0 " " " insoluble.

The part insoluble in water contained:

81.1 per cent of organic matter and loss.

18.8 " " " ash.

The part of the original material insoluble in water consists mostly of lime, with a small amount of magnesia and sulphuric acid. A slight residue resembling mica (probably from the dust of the soil) remains after the treatment with acid. Sulphur is present in sufficient quantities to be easily detected when ignited—doubtless from the sulphuring of the vines.

The soluble part of the original material was slightly acid. On ignition it blackens, and emits a slight odor of burnt sugar. The presence of a little sugar is also shown by the copper test. The soluble part of its ash is strongly alkaline and consists largely of carbonate of potash with some sulphuric acid.

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The general result of this examination would seem to be that the white substance is a saline incrustation of organic salts of potash and lime. Such a deposit might result from the evaporation of vine sap itself, but its deficiency in gum and sugar and apparent absence of tartaric acid (judging from the crystalline form of the incrustation) renders this supposition unlikely.

Other Specimens.—Another specimen sent by J. S. Dore, of Borden, Fresno county, had all the characteristic marks of the specimen from the Butler vineyard, except that the material was less abundant. A specimen from Hiram Hamilton, of Orange, Los Angeles county, differs in some respects from the Fresno samples. The deposit is much thinner and looks as though drops of thin whitewash had fallen upon the leaf and spread out upon it. It is most abundant upon or near the outer edges of the leaves. Examined with the microscope, the deposit does not show the needle-shaped crystals as in the former cases, but has instead somewhat irregular, roundish masses, sometimes contiguous, sometimes separated enough to show the green color of the leaf surface beneath them. There is, however, no indication of fungoid form or

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growth, but rather of granular formation, presumably an incrustation. The material was not abundant enough to admit of chemical examination.

A specimen received from G. F. Merriam, of Escondido, San Diego county, resembles closely the one from Orange, Los Angeles county. Mr. Merriam writes: "You will notice along the edges of the leaves something white—as if lime-water had been thrown upon them." In this sample the thicker line of incrustation along what seems to be the part where most of the liquid would collect by gravitation is a noticeable feature.

Further Investigation Needed.—We make this preliminary statement concerning the nature of these abnormal deposits upon vine leaves, because of the interest which has been awakened in them in the localities where they have occurred, and to allay fears which seem to prevail that the peculiar appearances are due to the presence of "downy mildew" (*peronospora viticola*)—a disease of the vine which is properly dreaded. The wide announcement which has been made of the evil occasioned by this fungoid parasite, naturally renders vine-growers alert to detect signs of its encroachment. It may be stated that the "downy mildew" exhibits its presence by marks wholly dissimilar to the characteristics of the incrustation which we have described above. It forms "conspicuous white patches" of a fuzzy or downy character, as its common name indicates. These patches may be very small, but their soft, woolly nature is easily detected. As the disease progresses the patches become yellowish, then brownish, and finally the portion of the leaf affected exhibits all the marks of dead tissue. Sometimes the leaf is almost wholly covered and shrivels and dies. Microscopic examination shows that the fungus has penetrated the leaf substance and destroyed it.

In the case of the incrustation noted above, the material is wholly upon the outer surface of the leaf, merely resting upon it and easily separated from it. Careful examination of the epidermis from which the material has been removed does not show any invasion of the tissue. Nor does it appear from the samples received that the deposit, whatever may be its origin, does any injury to the leaf or its functions. Upon this point we desire more information from those who have observed the occurrence and traced its effects.

We desire more liberal supplies of the material to pursue investigations which we trust may disclose the origin of the peculiar phenomenon. We would also be pleased to have all vine-growers whose attention may be attracted by this announcement, examine their vines and send us specimens of anything which may seem to them to be of the character described. In many cases serious apprehensions may be allayed by determination of the real nature of what may seem to be threatening phenomena, and even when the matter is serious it is well to be advised of it as early as possible. The University Experiment Station is equipped for such work and its facilities are always at the service of the vine-growers and of agriculturists generally.

An investigation into the causes of the mysterious decline and death of grapevines at certain points in Southern California has been in progress at the University Experiment Station for several weeks. The work was undertaken to test the results announced last year by reinvestigation, and because the loss and vexation resulting from death of vines continues in the same localities affected last year.

Quite a large collection of vines in different stages of decline was secured from the growers. In some cases the vine was almost lifeless and had made but the most feeble attempt to break its buds, in others one cane had made a fairly vigorous start while others did little or nothing; in others still all the buds had thrown out a few inches of very weak cane. Thus we had for examination vines in various morbid states. The examination of this material was also much helped by careful descriptions of the progress of the trouble by the growers and by personal investigation in the field by Mr. F. W. Morse. The results of the examination as to locating the trouble in the vine itself were mainly negative, as was the case last year. Although most careful microscopic examination of the leaves and wood of the affected vines was made, there was no parasite of either animal or vegetable nature found. In fact the tissue of leaf, cane and trunk was found to be perfectly normal, except that there were clear indications of defective nutrition resulting from a stoppage of the sap supply. Why this stoppage occurred there was nothing in the vines themselves to show. In some samples submitted, a part of the sap ducts were partly or wholly closed with gummy material, presumably the result of condensation of the small sap flow, because of lack of pressure to carry it onward to the nourishment of the newer growth, but there was not, on the whole, nearly sufficient obstruction to prevent the flow of sap had the flow been normal. In fact the decapitation of vines in the vineyard showed that there was in some cases very little sap flowing and in others none at all. This checking of the sap flow is not the immediate effect of parasite attack and where it sometimes results as a secondary effect, the tissue of the plant shows the disorganization produced by the earlier invasion of parasite growth. In the cases examined this source of trouble was plainly precluded because the tissue was normal and healthy, except in the noticeable deficiency in the sap flow. This fact was determined by repeated examination, both of cross and longitudinal sections of the new growth, the younger wood of the spurs, the trunk of the vine and the roots and rootlets—even to the smallest which could be found on the vines sent to us.

This conclusion is a verification of the results set forth last year by field examinations by Mr. Morse and by microscopic investigations in the laboratory—an account of which is given in the *Viticultural Report of the University for 1886* (page 176 *et seq.*), to which the reader is referred. His conclusion was that there was nothing found that would in-

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dicate a true disease which might increase and spread to neighboring vineyards, but that the phenomena were traceable to more or less accidental and local peculiarities of soil, season, moisture conditions, etc., which may not recur and produce similar effects for many years. It is altogether likely that the continued decline of vines observed this year is but the natural sequence of unfavorable conditions prevailing in the winter and spring of 1886. Since the loss has been greatest in districts where vines have been longest cultivated, it is possible that the evil has been aggravated by the gradual exhaustion of the soil; pointing to fertilization as at least a partial remedy and preventive by enabling the vines to rally from their enfeebled condition, through the recuperation of the root system.

Remedy for the Anthracnose of Vines.

A bulletin of the Agricultural Society of France, lately received from Mr. Chas. Joly (president of the Horticultural Society of France), gives the following information on the subject of the treatment of vines for anthracnose ("black blight," "sunburn," etc.)—*Sphaeloma ampelinum* :

The viticultural section of the Society of French Agriculturists has decided to render as public as possible the instructions given below, which have been published by the Bureau Directors of the Medoc syndicate under the signature of its president, Mr. N. Johnston, and whose object is to indicate the best means of dealing with the anthracnose of vines.

The members of the syndicate having repeatedly tried the application of sulphate of iron (copperas, green vitriol), have obtained satisfactory results, and intend to repeat its application on the whole of their vineyards. They do not intend to say that this remedy cures

the evil completely, but they believe that if practiced with care it greatly diminishes its ravages, and they advise the members of the association to try it. They even believe that where the vine has been most seriously attacked, two applications should be made at intervals of 10 or 12 days, such treatment having given excellent results.

The solution to be used should contain at least three pounds of copperas per gallon of water, to which may also be added two ounces of copper sulphate or bluestone. The solution is best made in hot water, and it should not be allowed to get very cold, so that it may not deposit a portion of the dissolved substance.

The application is made with a brush, to the wood of the vine, taking care that all parts of the vine, from the base of the stock to the ends of the canes, are moistened with the solution. The capital point is, however, that at least the wood of the last three years should be well wetted.

The amount of copperas used is about 45 pounds per acre of (long-pruned) vines (on short-pruned kinds, of course, materially less in proportion).

The application should be made before the vines bud out, since the strong solution would seriously injure the tender foliage.

Experiments with sulphate of copper alone have also been tried and seem conclusive, but were on too small a scale to be made a rule. The use of a solution containing five per cent, or $2\frac{1}{2}$ ounces, per gallon of water appeared perfectly effective; weaker solutions were not altogether satisfactory in their action.

While it is too late to apply these remedies in California this season, in the precise manner indicated, those noting symptoms of the disease on their vines might try spraying with weaker solutions, in order to check its progress, or at least to prevent its spread to neighboring vines.

E. W. HILGARD.

Berkeley, June 4, 1887.